REMARKS

Claims 14-31 are pending, claims 29-31 having been added to provide applicant with a more complete scope of protection. Claims 14, 19, 22 and 31 are independent.

Claims 14, 16 and 21 were rejected under 35 U.S.C. 103 over Jung (5,674,759), in view of the newly cited Mine et al. (5,370,904), claim 17 and 18 over Jung and Takahisa, and claim 19 over Jung in view of Mine and further in view of applicants admitted prior art. In addition, claims 22, 24, 27 and 28 were rejected under 35 U.S.C. 103 over the same Jung patent in view of Mine and further in view of Bai and claims 25 and 26 over Jung in view of Mine and further in view of Bai and Takahisa. All of these rejections are respectfully traversed.

With regard to the rejection of claim 14, Jung forms a plasma nitride layer 11, covers the plasma nitride layer with a capping layer 12, and heats the substrate to release hydrogen from the plasma nitride layer 11. Mine heats a hydrogen silsesquioxane resin to convert it into silicon oxide ceramic. In Mine, it is stated that heating is done in such a manner that the content of silicon-bonded hydrogen in the silicon oxide product has reached 80 % or less of the content of silicon-bonded hydrogen in the hydrogen silsesquioxane (see Abstract). On the other hand, Applicant's claim 14 recites "SiH residue of 61 % or less", which is not disclosed in the references.

1) Mine teaches that SiH residue of more than 61% and not more than 80% is equally preferable to a level of at most 61%. For producing a Si-H residue of more than 61% and not more than 80%, the heat treatment condition for forming the silicon oxide ceramic should be weakened as compared to that of the applicant's heat treatment. If this is done, sufficient conversion into silicon oxide ceramic is not realized, and the quality of the oxide will be structurally weak (fragile and easy to generate cracks). Such an oxide film is not sufficient for the material of an interlayer insulating film of integrated circuit device.

2) In the silicon oxide film formed by the above-mentioned insufficient heat treatment, water-derivative species (H_2O, OH-, etc.) will remain. There arises a possibility that the remaining water-derivative species will invite deterioration of transistor characteristics (e.g., shift of threshold voltage (Vt), variation of slow trap centers, negative bias temperature instability, etc.).

In the formation of a silicon oxide film, it is necessary to adopt a rather moderate condition to retain a certain amount of silicon-bonded hydrogen (Si-H) in the silicon oxide film to enable generation of hydrogen in the later heat treatment process to reduce the interfacial energy levels (surface states). But, for avoiding the above-mentioned inconveniences 1) and 2), it is necessary to employ relatively strong conditions in the heat treatment for forming the silicon oxide film. The heat treatment conditions that realizes the Si-H residue of 61% or less in the silicon oxide film, will not allow the above-mentioned inconveniences 1) and 2), whereas those conditions which will leave Si-H residue to more than 61% may allow generation of the above-mentioned inconveniences 1) and 2).

New dependent claim 29 is supported at least at Table 1. New dependent claim 30 is supported at least at Fig. 5 and the related description, especially page 20, lines 3-5.

In view of the above, claim 14 is believed clearly patentable over the cited references.

As to independent claim 19, Jung and Mine do not teach formation of a surface protection film covering the wiring layers, the surface protection film having such a thin thickness that an air-filled groove is formed between adjacent wiring layers. Preferably, the groove should be at the same level as the wiring layers, and should not be above the level of the wiring layers.

Fig. 6 of the present application shows prior art in which a surface protection film 3 made of silicon nitride covers wiring layers 2A and 2B. There is formed a groove in the

surface of the silicon nitride layer 3 between the wiring layers 2A and 2B at a level higher than the wiring layers 2A and 2B. No groove is formed between the wiring layers 2A and 2B. When a surface protection film is formed of a film which does not transmit hydrogen such as a silicon nitride film, reduction of surface states by hydrogen annealing cannot be used. If the silicon nitride layer is made thin as shown by broken line 3a to produce a groove between the wiring layers 2A and 2B, the groove will be filled with air to reduce the electrostatic capacitance (parasitic capacitance) of the wiring layers 2A and 2B. The silicon nitride film formed by plasma CVD contains un-reacted hydrogen, and can be used as the source of hydrogen for reducing the surface states. When the silicon nitride film is made thin, the amount of hydrogen which can be supplied from the silicon nitride film becomes insufficient.

In the invention defined by claim 19, hydrogen is included in the interlayer insulating film. Thus, it is enough to use a surface protection film which has a hydrogen transmission preventing function, and does not have a function of providing hydrogen. It becomes possible to use a thin surface protection film which produces a groove between the wiring layers 2A and 2B. The cited references do not teach incorporating a surface protection film made thin to produce a groove between adjacent wiring layers in a structure having a hydrogen-containing film in the interlayer insulating film. For at least these reasons, claim 19 is believed patentable over the cited references.

With regard to independent claim 22, Jung and Mine do not disclose forming silicide layers on the silicon gate electrode and on the source/drain regions. Bai forms silicide electrodes on the gate, source and drain of a MOS transistor. Bai, however, does not teach incorporating a hydrogen-containing film in the interlayer insulating film covering the MOS transistor provided with silicide layers on the gate, source, and drain.

For at least the foregoing reasons, Applicant submits that no suggestion of employing an interlayer insulating film including a hydrogen-containing film in the MOS transistor provided with silicide layers on the gate, source, and drain can be obtained from the cited references. Therefore, claim 22 is believed clearly patentable over the cited references.

New independent claim 31 is newly presented and is believed to be patentable over the cited references.

The other claims are dependent upon an independent claim discussed above and are believed patentable at least for that reason. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual consideration, or reconsideration, as the case may be, of the patentability of each on its own merits is respectfully requested.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. According, the Examiner is respectfully requested to pass this application to issue.

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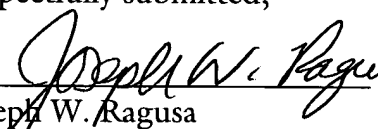
Respectfully submitted,

By 

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